Segment No. 16-34-02 WA-34-1020

PULLMAN SEWAGE TREATMENT PLANT CLASS II INSPECTION; SEPTEMBER 16-17, 1986

by

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#### ABSTRACT

A Class II inspection was conducted at the Pullman Sewage Treatment Plant (STP) on September 16 and 17, 1986. The facility, a bio-tower/activated sludge secondary plant discharging into the South Fork of the Palouse River, was providing good biochemical oxygen demand (BOD<sub>5</sub>) and total suspended solids (TSS) removal. Reduced effluent ammonia and chlorine residual concentrations were observed in comparison to a pre-upgrade survey conducted in 1978. All parameters were below or within National Pollutant Discharge Elimination System (NPDES) permit limits, with the exception of the effluent ammonia concentration which exceeded the allowed monthly average. Collection of limited receiving water data by STP personnel is suggested to help evaluate the ammonia permit limits.

#### INTRODUCTION

A Class II inspection was conducted on September 16 and 17, 1986, at the Pullman Sewage Treatment Plant (STP). The inspection was a follow-up to a pre-upgrade Class II inspection/receiving water survey done by the Water Quality Investigations Section (WQIS) on September 12 and 13, 1978 (Bernhardt and Yake, 1979). Conducting the inspection were Carl Nuechterlein from the Ecology Eastern Regional Office (ERO) and Marc Heffner from the Ecology WQIS. Terry Dokken, chief operator at the STP, and Al Prouty, plant process analyst, provided assistance. The inspection was conducted in conjunction with an Ecology receiving water study on the South Fork of the Palouse River. The receiving water results are presented in a separate report (Joy, in preparation).

The Pullman STP is a secondary plant that provides seasonal nitrification. Treatment units include two primary clarifiers, a bio-tower, two activated sludge basins, two secondary clarifiers, and chlorination/dechlorination facilities (Figure 1). Treated effluent is discharged into the South Fork Palouse River, as limited by NPDES permit #WA-004465-2. Sludge from the process is thickened, anaerobically digested, dried using a belt filter press, then spread on agricultural land. A paved lagoon is used for sludge storage when field conditions do not allow spreading.

#### Objectives included:

- 1. Collect samples and measure flow to estimate plant efficiency and NPDES permit compliance.
- 2. Review laboratory procedures (including sample splits with the STP laboratory) to estimate accuracy of results and conformance with approved analytical techniques.
- 3. Provide data for consideration as part of the receiving water study.

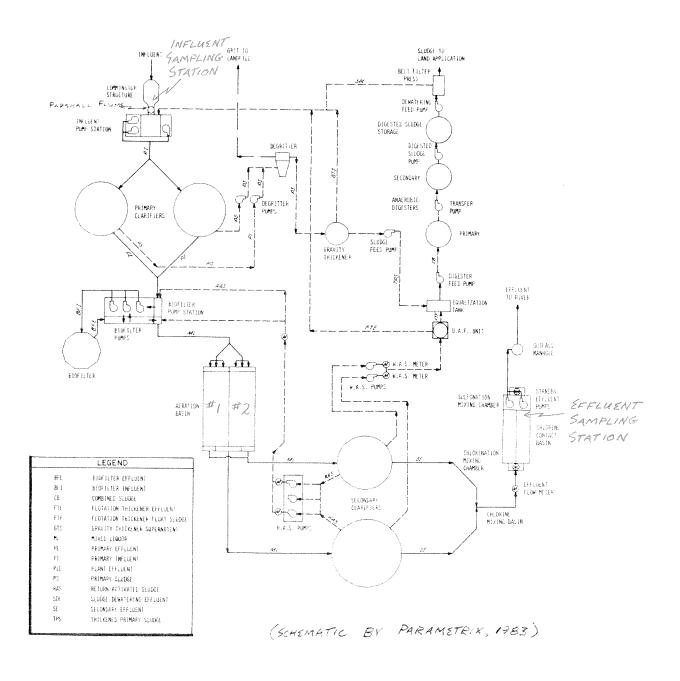


FIGURE 1 - FLOW SCHEME - PULLMAN, 9/86.

#### **PROCEDURES**

Grab and composite samples were collected during the inspection. Ecology composite samplers collected influent and effluent samples (Figure 1). The samplers collected approximately 220 mLs of sample every 30 minutes for 24 hours. Composite samples collected by the Pullman STP included a flow-paced influent sample and a time-paced effluent sample. The effluent sampler collected approximately 150 mLs of sample every 45 minutes. The Pullman influent sampler plugged during the sampling period, resulting in an incomplete sample. All composite samples were split for analysis of selected parameters by the Ecology and Pullman STP laboratories. Sampling times and parameters analyzed are included on Table 1.

Ecology grab samples were collected for field and laboratory analyses (Figure 1). Samples collected and parameters analyzed are summarized on Table 1.

Instantaneous Ecology flow measurements were made at the influent Parshall flume. The operator reported that the in-line effluent flow meter is not accurate at the usual plant flow rate, so it was not being used during the inspection.

#### RESULTS AND DISCUSSION

Data collected during the inspection are summarized in Table 2 (Ecology Analytical Results) and Table 3 (Flow Measurements).

Table 3 - Flow measurements - Pullma	10	TAC	mescurements	-	P11 ] ]	man.	Q.	/86.
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Dat	е	-	Instantan-	Total-	Flow for time increment
Month	Day	Time	(MGD)	reading	(MGD)
9	16	1150	-	29929 *	2.15
9	16	1510	2.80+	2408	
9	17	0820	5.78	21770	2.71 4.82
9	17	1050	3.90	26786	4.02
	ΑV	rerage flow	during ins	pection =	2.85

<sup>\*</sup>totalizer reset to zero at approximately 1200 hours each day. Meter was reset from approximately 30500 on 9/16.

<sup>+</sup>Ecology instantaneous measurement 2.9 MGD (assumes standard 18" Parshall flume)

Table 1 - Sampling schedule and parameters analyzed - Pullman, 9/86.

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	9/17	0850			< ×	‡ x	< ×					×																
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\*grab samples are sampled and analyzed by Ecology unless otherwise specified \*\*before dechlorination \*+after dechlorination +1nhibited BOB also run +TpH meter malfunctioned

Table 2 - Ecology analytical results - Pullman, 9/86.

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	9/17			23.7	<u>;</u> ‡							ń																
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Aeration Basin #1	9/16	1050 0850		22.2					3.0-4.0								1400 27	270										
Aeration Basin #2	9/16 9/17	1055 0850		22.1					3.0-4.0							,	1500 26	260 250										
Effluent 9/16	9/16	1130 1315 1340		21.5	21.5 7.0	575	<0.1*	0.1*		160	2100	-	Ŋ	53		2	20	4	1.7	1.3	23	5.6	6.5	7.2	632	120	77	
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		1045								7.1																		
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	81/6	9/18 0800	TEMEL LINES				0.0***					7		4				-4	1.9		25	5.8		7.4	199	120	43	
	1404	the form don't last																***************************************					-					

\*before dechlorination \*\*after dechlorination +inhibited BOD results

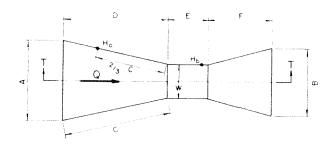
Day BOD (mg/L).
5 4.1
10 8.1
14 9.8
20 14

#### Plant Operation

Figure 1 provides a schematic of the plant flow. Influent flow passes through the headworks/flume area into a wet well where it combines with return flows. Measurements of the Parshall flume and head heights were made by Ecology. Table 4 compares the field measurements with specifications for a standard 18-inch Parshall flume. The field measurements indicate that the throat of the flume does not meet standard specifications. Comparison of Ecology instantaneous head height measurements with the instantaneous in-plant flow meter suggests that the meter is calibrated as an 18-inch flume (Table 3). The plant flow measurements are probably slightly higher than the actual flow. The effluent flow meter should be repaired and used. The influent flume can be used as a rough check of effluent flow meter accuracy.

Table 4 - Comparison of STP flume to standard flume dimensions\* - Pullman, 9/86.

	Standard	
	dimension	STP flume
Measurement	(in)+	(in)
A	40 3/8	40 1/4
В	30	30 3/8
С	57	58 5/8
2/3 C	38	38
E (side 1)	24	21 1/2
E (side 2)	24	20 1/2
W	18	17 1/4**



<sup>\*</sup>standard dimensions and flume diagram from Stevens (1978)

Flow then passes through the primary clarifiers and into a splitter box where it is combined with the bio-filter return flow. Sludge depth measurements showed sludge accumulation in the primary clarifiers was minimal, ranging from six inches to one foot. From the splitter box a portion of the flow is sent to the bio-tower while the remainder is combined with the return activated sludge (RAS) and sent to the

<sup>+</sup>for 18" flume

<sup>\*\*</sup>estimate; walls were bowed so throat width variable

aeration basins. Bio-tower loading is maintained at approximately 90 lbs  $BOD_5/D/1000~{\rm ft}^3$  of media to avoid odor problems that occur at higher loadings.

Dissolved oxygen (D.O.) concentrations in the aeration basins are maintained at approximately 3.0 mg/L. The high D.O. is maintained to encourage nitrification. Ecology D.O. measurements made on 9/16 at 1040 hours using a YSI D.O. meter ranged from 3.0 to 4.0 mg/L (Table 2); within 0.5 mg/L of the permanent in-tank meters at the plant. The in-tank meters indicated that D.O. concentrations ranged from 2.7 to 4.2 mg/L on 9/17 at 0830 hours. MLSS concentrations were maintained in the 1300-to-1500 mg/L range (Table 2).

Aeration basin effluent is routed to the secondary clarifiers. Sludge depth measurements in the secondary clarifiers ranged from zero to one foot. The clarified effluent is routed to the chlorine contact basin for chlorination followed by dechlorination and discharge into the South Fork of the Palouse River. Sludge depth at the tail end of the chlorine contact chambers ranged from 1.5 to 1.75 feet in 6 feet of water. Al Prouty reported that the basin had been cleaned the week before, indicating fairly rapid deposition.

The chlorination/dechlorination process is a flow proportional system tied into the influent flow meter (it was tied into the effluent flow meter until meter inaccuracies were discovered). The chlorine residual concentration is monitored at two locations. A sensor at the head end of the contact basin continuously monitors the concentration and controls the chlorine dosing rate. A sensor at the tail end monitors the chlorine residual prior to dechlorination and controls the rate of  $\rm SO_2$  addition. Every two hours the tail end meter switches to a sensor located after dechlorination which monitors the actual discharge concentration for 15 minutes. Al Prouty reported that meter precision is approximately  $\pm$  0.06 mg/L, greater than the permitted 0.02 mg/L effluent concentration.

Sludge handling at the plant involves several processes. Sludge from the primary clarifier is gravity thickened while waste activated sludge (WAS) is thickened using dissolved air flotation. The two thickened sludges are mixed then anaerobically digested. The digested sludge is dewatered using a belt filter press. The dried sludge is applied on agricultural land. A paved holding lagoon is used to store the dried sludge for later land application when immediate application is not possible.

#### Data Analysis

The inspection data show that good BOD<sub>5</sub> and TSS reductions were occurring (Table 2). Table 5 compares inspection data with applicable design capacity data from the NPDES permit. Although the inspection flow was slightly greater than the dry-weather design, the BOD<sub>5</sub> and TSS loads were far enough below capacity that the plant appears well within design capacity.

Table 5 - Comparison of inspection data to NPDES permit design criteria - Pullman, 9/86.

	Permit Design Capacity	Inspection Data*
Monthly average - dry-weather flow (MGD)	2.7	2.85
Influent BOD <sub>5</sub> loading (1bs/D)	6000	4300
Influent TSS loading (lbs/D)	6100	3100

<sup>\*</sup>Ecology analysis of Ecology composite samples.

The influent was unusually dark when the 1030 hours grab sample was collected on September 16. Laboratory analysis found the sample to be highly colored (1800 units), with a slightly elevated TSS concentration (400 mg/L) and typical COD (Table 2). Determining the source of the discoloration was not pursued.

Table 6 compares data collected prior to the upgrade with inspection data (Bernhardt and Yake, 1978). Effluent quality improvements in  $\rm NH_3-N$  and chlorine residual concentrations are most noticeable. The higher  $\rm BOD_5$  effluent concentration observed during the 1986 inspection is probably due to nitrification during the test as the inhibited  $\rm BOD_5$  (CBOD\_5) was approximately 13 mg/L less than the  $\rm BOD_5$  (Table 2).

The difference between the BOD $_5$  and CBOD $_5$  would likely increase during spring when the plant begins to nitrify, and fall when nitrification slows down. Pullman should consider running both BOD $_5$  and CBOD $_5$  tests on effluent samples to determine how much of a problem nitrogenous oxygen demand is during the test. If the problem causes difficulty meeting the BOD $_5$  permit limit, they may wish to request CBOD $_5$  effluent limits.

Comparison of inspection data with NPDES permit limits is presented in Table 7. All parameters were within monthly permit limits except the NH $_3$ -N effluent concentration. Possible methods to attain additional NH $_3$ -N removal with the present facility include:

- 1. Additional BOD removal by the bio-tower may encourage additional nitrification in the aeration basins. This may not be practical because the bio-tower is presently being loaded at the maximum rate at which nuisance odors do not occur.
- 2. Increase MLSS concentrations in the aeration basins to encourage a higher sludge age and thus encourage a higher population of nitrifying organisms. Operator experimentation could determine the practicality of a higher MLSS.

Table 6 - Comparison of 1978\* and 1986 inspection data - Pullman, 9/86.

THE PROPERTY OF THE PROPERTY O	Flow (MGD)	2.85	2.66			-
Į.	Conductiva (ms\sodmu)	740	612	593		
	T-LatoT	6.4	5.9	3,3		
	d−μ0q−0	3.1	3,5	3.0		
I/gm) s	N−£ ON	0.07	<0.02	<0.02		
Nutrients (mg/L)	N-2ON	0.01	<0.02	<0.02		
	N-EHN	19	14.4	13,1		
(UTN)	Turbidity	32	72	4		
	SSANL	20	54	2		
Solids (mg/L)	SSI	130	190	5		
lids	SANL	330	341 300	289		
So	S.L	620	635	368		
(	COD (mg/L	400	329	29		
r)	BOD <sup>S</sup> (mg/	180	136	<b>4</b>		
	Fecal Col				71-200 10 est.	
eniro	Total Chl Residual (mg/L)				<0.1 1.5-1.6	
be	Sample Ty	Comp.	Comp.		Grab	
	Date	9/16-17/86	9/12-13/78	9/12-13/78	9/16–17/86 9/12–13/78	
	noitstS	o Influent	Effluent			

\* = 1978 data from Bernhardt and Yake (1979) est. = estimated + = inhibited  $BOD_5$  - 4.1 mg/L

Table 7 - Comparison of inspection data to NPDES permit limits -Pullman, 9/86.

	NPDES Perm	it Limi <b>t</b> s	Insj	pection Da	ta+
	Monthly	Weekly	Ecology	STP	Grab
Parameter	Average	Average	Composite	Composite	Samples
BOD 5					
5 (mg/L)	30	45	17	18	
(1bs/D)	900	1350	404	428	
(% removal)	85		91	*	
TSS					
(mg/L)	30	45	7	6	
(1bs/D)	915	1373	166	143	
(% removal)	85		95	*	
Fecal coliform	200	400			160;200;
(#/100 mL)					160;71
pH (S.U.)	6.0 ≤ 1	pH ≤ 9.0			7.0;7.0
Flow (MGD)	4.3		2.85	2.85	
NH <sub>o</sub> -N (mg/L)					
$^{NH}_{3}$ -N (mg/L) (12/1 - 3/30)	Bring.				
(4/1 - 4/30)	5				
(5/1 - 10/30)	1		2.0	1.9	
(11/1 - 11/30)	5				
Chlorine residual (mg/L)	<0.02				<0.1

<sup>+</sup>Ecology laboratory analyses
\*Influent compositor malfunction prevented calculation

3. Improving the environment in the aeration basins may encourage further nitrification. High D.O. concentrations are maintained in the basins to encourage maximum growth rates (2.7 to 4.2 mg/L during the inspection). The pH should also be considered. Effluent pH during the inspection was 7.0 and the alkalinity was 120 mg/L. Maximum nitrification is thought to occur in the pH range of 7.2 to 9.0 (Metcalf and Eddy, 1979). When using fine bubble diffusers, maintaining an alkalinity of 175 mg/L as CaCO<sub>3</sub> is predicted as necessary to keep the pH at 7.2 (EPA, 1975). Review of effluent pH data from several months of DMR data is presented in Table 8. The data suggest that pH may be inhibiting nitrification at the plant. Monitoring pH and alkalinity in the secondary system and adjusting as necessary may improve nitrification efficiency.

Table 8 - DMR Effluent pH Data - Pullman, 9/86.

Date	pH range (S.U.)
6/86	6.4 - 7.1
5/86	6.4 - 7.0
4/86	6.4 - 6.8
3/86	7.0 - 7.3
2/86	6.3 - 7.0
1/86	6.6 - 7.0
12/85	6.4 - 7.0

The NH $_3$ -N permit limits were reviewed to estimate the NH $_3$ -N toxicity protection provided in the receiving water. The one-hour and four-day NH $_3$ -N toxicity criteria for the South Fork of the Palouse River were calculated using Ecology ambient water quality monitoring data from station 34B110 located at the State Street bridge upstream of the STP (EPA, 1986; Ecology, 1986). Individual criteria were calculated for each monthly sample collected in water years 1982-1986. The allowable NH $_3$ -N concentration in the STP effluent at which the criteria would not be exceeded was then calculated for the inspection and maximum permitted flow rates. Figures 2-5 compare the allowable effluent concentrations to the existing permit limits. Applicable formulas and calculations are provided in Appendix I.

The figures suggest the existing permit limits usually provide adequate one-hour criteria protection, but often fail to provide adequate four-day protection. Unfortunately, downstream ambient receiving water data are not available to more accurately estimate actual toxicity criteria. Receiving water data collected during the inspection showed the effluent significantly changes receiving water pH and temperature, decreasing NH<sub>3</sub>-N toxicity in the receiving water (Joy, 1987). Table 9 summarizes NH<sub>3</sub>-N toxicity-related changes near the STP.

Collection of upstream (State Street Bridge) and downstream (Old City Dump Road Bridge) pH and temperature data on a routine basis by STP personnel is suggested so  $NH_3-N$  effluent limits can be properly

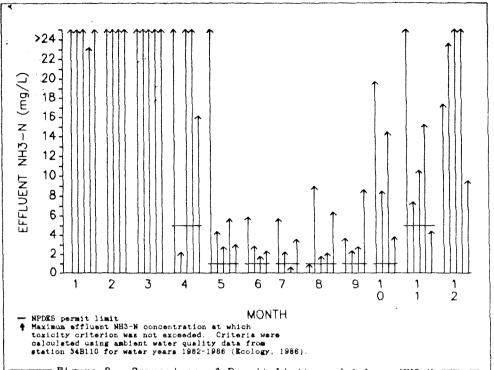
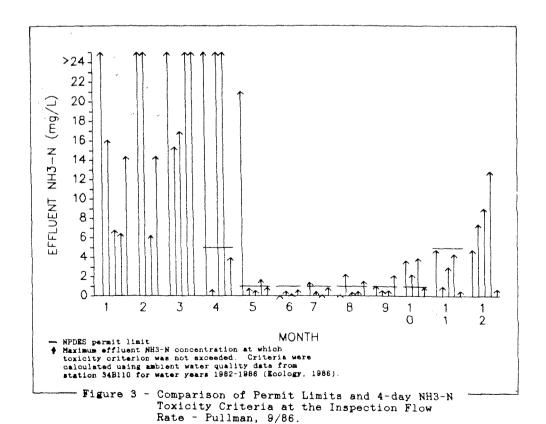
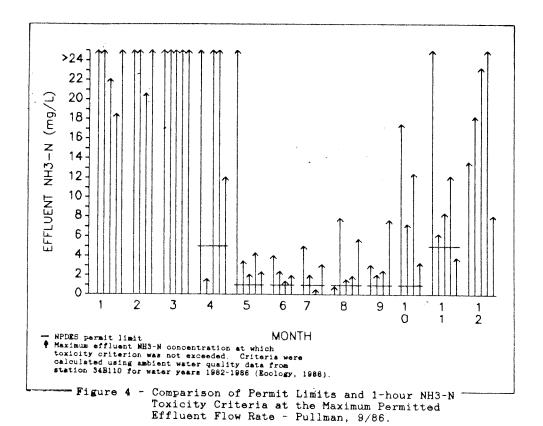


Figure 2 - Comparison of Permit Limits and 1-hour NH3-N Toxicity Criteria at the Inspection Flow Rate - Pullman, 9/86.





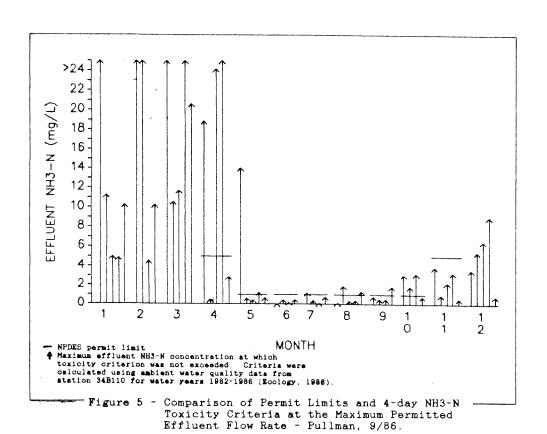


Table 9 - Upstream and Downstream Ammonia Toxicity Criteria Comparison\* - Pullman, 9/86.

					Percent	Toxicity	Criteria		Coxicity Criteria
			Temp.	Temp. pH	un-fonized	(mg/L un-ionized NH2-N)	ized NH2-N)		(N-,-H)
Station	Date	Time	(၁۸)	(S.U.)	.) NH <sub>3</sub> -N	1-hour	4-day		4-day
					And many company of the formal property and the company of the com	The state of the s	CONT. LANCE TO SERVICE THE PARTY OF THE PARTY.		STATE OF THE PARTY
Upstream**	9/16	1400	1400 15.6	7.9	2.22	0.150	0.029	6.8	۳. د
Downstream**	9/16	1230	18.1 7.5	7.5	1.08	0.131	0.019	12.1	1,8
$Upstream^{**}$	9/17	1010	010 12.3 7.9	7.9	1.74	0.119	0.023	6,8	ر د
Downstream** 9/17	9/17	0630	1930 17.0 7.3	7,3	0,63	0.096	0.011	15.2	I.8

\*\*Upstream samples taken at State St. Bridge; downstream samples taken at Old City Dump Road Bridge \*Data from Joy (in preparation)

reviewed and changed as necessary. Collection of data two times per day (early morning and midafternoon) once per week should be adequate.

The dechlorination system deserves further analysis. Al Prouty reported that the maximum SO, injection rate is 24 lbs/D. At the peak flow rate measured during the inspection (5.78 MGD), that rate would be adequate to remove a chlorine residual of 0.5 mg/L (calculation assumes 1 mg/L SO, removes 1 mg/L chlorine residual; WPCF, 1977). Ecology chlorine residual concentration measurements roughly corresponding to the peak flow rate were 0.3 mg/L prior to dechlorination and <0.1 mg/L after chlorination. Reserve capacity of the SO, system appears minimal; an increase should be considered in the near future.

Metals analysis results from the digested sludge sample are presented in Table 10. The results indicate that the Pullman STP sludge was within the range of concentrations found at activated sludge plants statewide during previous Class II inspections.

Table 10 - Sludge metals data - Pullman, 9/86.

		Summary of	f Statewide Data	a*
				Number
	STP Sample**	Range	Geometric Mean	of
Metal	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	Samples
Cadmium	5.0	<0.1 - 25	6.9	28
Chromium	62	15 - 300	60	28
Copper	426	75 - 1700	370	28
Lead	90	34 - 600	220	28
Nicke1	22	<0.1 - 62	22	24
Zinc	890	165 - 3370	1160	28

<sup>\*</sup>summary of data collected during previous Class II inspections at activated sludge plants throughout the state 
\*\*percent solids = 27%

#### Laboratory Procedures Review

Laboratory procedures were reviewed with Pullman STP staff by Ecology roving operator Otis Hampton. A copy of the "Laboratory Procedural Survey" he completed is included in Appendix II.

Results of samples split for analysis by both the Ecology and Pullman STP laboratories are presented on Table 11. Results for most samples compare closely, although the Pullman STP TSS results were greater in all cases. Completed TSS test filters should be redried and reweighed to assure they are being adequately dried. Once adequate drying is assured, quarterly rechecks using the redry/reweigh technique are suggested for quality assurance.

Table 11 - Comparison of split sample laboratory results - Pullman, 9/86.

Station	Sampler	Laboratory	BOD <sub>5</sub> (mg/L)	TSS (mg/L)	NH <sub>3</sub> -N (mg/L)
Influent	Ecology	Ecology Pullman	180 202	130 152	19 22
	Pullman*	Ecology Pullman	250 275	250 282	24 21
Effluent	Ecology	Ecology Pullman	17 19	7 12	2.0 2.2
	Pullman	Ecology Pullman	18 24	6 14	1.9 2.2

<sup>\*</sup>compositor malfunction prevented collection of a complete sample

#### RECOMMENDATIONS AND CONCLUSIONS

The STP was providing good BOD<sub>5</sub> and TSS removals, and substantial nitrification during the inspection. Effluent parameters were below or within NPDES permit limits with the exception of the NH<sub>3</sub>-N concentration which was greater than the allowed monthly limit. Increasing MLSS concentrations and/or controlling pH in the aeration basins may increase NH<sub>3</sub>-N removal. Comparison of the permitted ammonia discharge to receiving water toxicity criteria was inconclusive due to pH and temperature impacts the discharge has on the receiving water. Limited receiving water monitoring by STP personnel as outlined in the discussion is recommended.

Other areas discussed that may need further attention include:

- The throat of the influent Parshall flume being used for flow monitoring was not standard, likely decreasing accuracy. Repair and use of the in-line effluent flow meter is suggested.
- 2. Sludge seemed to be accumulating rather quickly in the chlorine contact chambers. Frequent monitoring and sludge removal as necessary are suggested.
- 3. Preliminary calculations suggest that the capacity of the SO injection system is being approached during daily peak flows. Capacity should be checked and increased if necessary.
- 4. The difference between the BOD, and CBOD, test results in the effluent suggests that the nitrogenous oxygen demand may influence the BOD, test. The city should consider running side-byside BOD, and CBOD, tests, especially during transition periods in and out of nitrification, to see if they should pursue any CBOD, permit limits.

Sample splits suggested that the STP laboratory was analyzing samples accurately. Checks to assure that TSS filters are completely dried during the analysis are suggested.

#### REFERENCES

- Bernhardt, J. and W. Yake, 1979. "Assessment of Wastewater Treatment and Receiving Water Quality South Fork of the Palouse River at Pullman, Washington," Washington State Department of Ecology. Project Report DOE-PR-5, February 1979.
- Ecology, 1986. Retrieval of Ambient Water Quality Data for Station 34B110. Water Quality Investigations Section, Olympia.
- EPA, 1975. Process Design Manual for Nitrogen Control, October 1975.
- EPA, 1986. Quality Criteria for Water, EPA 440/5-86-001, May 1, 1986.
- Joy, J. (in prep). Report on the South Fork of the Palouse River Receiving Water Investigation; September 16-17, 1986.
- Metcalf and Eddy, 1979. <u>Wastewater Engineering/Treatment Disposal/</u>
  Reuse, 2nd Ed.
- Parametrix, 1983. "Pullman, Wash. Wastewater Treatment Plant Improvements."
- Stevens, 1978. Stevens Water Resources Data Book, 3rd Ed., April 1978.
- WPCF, 1977. Wastewater Treatment Plant Design, MOP/8.

### APPENDIX I

Calculation of  $\rm NH_3-N$  toxicity information. Appropriate formulas taken from EPA (1986).

1-hour criteria (mg/L un-ionized NH<sub>3</sub>-N) = 
$$\frac{0.52}{\text{FT x FPH x 2}}$$
 x 0.822

where:

FT = 
$$10^{\circ} [0.03(20-T)]$$
  
FPH = 1 if 8 < pH < 9\*  
=  $\frac{1 + 10^{(7.4 - pH)}}{1.25}$  if  $6.5 \le pH \le 8$ 

4-day criteria (mg/L un-ionized NIi<sub>3</sub>-N) = 
$$\frac{0.80}{\text{FT x FPH x ratio}} \times 0.822$$

where:

Ratio = 16 if 
$$7.7 \le pH \le 9*$$

$$= \frac{24 \times 10^{(7.7 - pH)}}{1 + 10^{(7.4 - pH)}} \text{ if } 6.5 \le pH \le 7.7$$

Flow rates for calculating the maximum downstream load = SF Palouse flow + STP flow.

	Crite	ria
	1-hour	4-day
Inspection flow (MGD)	6	2.85
Maximum permitted flow (MGD)	9	4.3

\*An FPH of 1 and a ratio of 16 were used when the pH exceeded 9.0.

Table La - Calculation of acceptable NHS-M discharge concentrations for STP design flow conditions - Pullasn, 9/86.

			MPDES NH3-N	limits (mg/L)																		9	3 5	8	90	5.00	90	20.1	20.5	200	1.00	8	3 2	20.1	00:1
				4 day		168.248	11.258	5.010	4.886		206.265	50,246	4,552	10,246		72,657	10 581	11.718	20 01	20.00	20.614	7.88 8	0.677	26 153	74 416	2.888	14 041	1170	127	306	0.643	1 404	0.475	0.708	0.499
	P affluent	concentrations (mg/L)	#-CHW	i hour		842.231	34,865	22.091	18,530		840.729	156, 983	20,609	37,249		196,904	17. AB4	3B, 553	570 911	70 171	61.366	57, 130	. 468	76.440	231, 224	12,038	54 547	1.66.6	2 120	A 703	2,360	4.053	7.474	100	2,011
	inealis 9 (F) attions	oncentrati	XH3-X	4 day		7##*0	6.0.0	0.034	0.028		0,557	0.314	0.049	0.048		0.453	0,181	0,117	0.110	0 250	407.0	0,254	0.147	0.274	0.449	0,075	0.955	0.094	0.081	0.094	0,080	. 818	0.064	0.062	0,083
	î		unionized	1 hour	070		0.244	0.149	0.106 0.169	,	2.270	0.981	0.220	0.176		1.226	0.575	0,385	0.428	717	0.173	0.704	0.507	0.868	1,387	0.313	3,004	0.532	0.394	0.330	0,295	2,109	0.367	0.418	0,334
	11 11 11 12 12 12 13 13 14 14 14 14 14 14 14 14 14 14 14 14 14		auce	A day	570 ST	200.0	778.7	1.213	1.006		19.472	11.262	1,743	1,734		16,233	6.473	4.198	3.943	0	300	9.123	5,263	9,831	16,119	2.690	34,265	3,385	2,900	3,357	2,880	-65,181	2,301	2,211	2.970
	#		STP allowance	1 hour	675 8V)	707 '01	CA7.81	11.172	7,984		1/0,384	73.645	16.521	13.197		92.030	43,133	28.909	32, 133	50 174	101.00	52,824	38.038	65,122	104,134	23,465	225,470	39.945	29.541	24.796	22.132	158.267	27.562	31,372	25.057
:	unionized NH3-N (16s/d)			upstream . load	7.687	201.0	0.740	7/9*6	0.167	i	1.465	909.0	1.148	0.527		1.222	1.313	1,002	0.511	1.407	744.1	0.393	1.094	2.569	0.873	1.340	10,270	2.087	2.242	0.642	0.512	116.639	1.000	3,024	0.286
	unionized	€ DE	table am load	4 days	10 14,0	100.11	3.107	C88.	2,164		21.43/	11.868	2.842	2,261		17.455	7.786	5.200	4,455	10 791	10.71	9.516	6.357	12,401	16.993	4.029	44,535	5.472	5,142	3.999	3,391	51.458	3,301	5,235	3,256
	bazionium essessessessessesses	Sex 2 sec	acceptable downstream load	1 hour	152 049	10.10	0/0.01		13,179		1/2, 548	/4.251	17.669	13.724		93,252	44.446	29.911	32,644	767 65	37.060	53,216	39, 132	159.79	105.007	24.805	235,741	42.032	31,783	25,439	22.644	274,906	28.562	34,396	25.343
		***********	Criteria	(MH3-M	8 005	0000	710.0	9,010	0.010	000	0.00	0.012	0.013	0,010		0.012	0.019	0.014	0,007	0 017	70.0	0.018	0.030	0.016	0.011	0.019	0.020	0.041	0.025	0.023	0.024	0.036	0.041	0.035	0.041
un.	4 08/	***********		н	1, 589	2 100	2.100	0,870	3,654	,	3.172	7.30/	3,192	3.565		2.818	2,123	2.780	2.999	7 775	6/7.7	2.138	1.384	2,489	2,388	2.183	2,023	1.000	1.667	1.811	1.679	1.148	1.000	1.172	1.000
a) cui at 1 on	; ; ; ; ; ; ;	6 6 8 8 8 8 8 8 8		Ratio	77. 943	000 71	000 11	10.000	16,000		25, 745	18.372	16,000	16,000		16,000	16.000	16,000	21.199	14.000	000.01	16,000	16,000	16.000	18.525	16.000	16.000	16.000	16,000	16,000	16.000	16.000	16.000	16.000	16.000
2 2 1 2 1 2 2			Criteria unionized	MH3-N (ag/L)	0.037	670.0	700.0	700'0	0.052	0	750.0	0.07	0.067	0.050		0.063	0.101	0.073	0.050	0.089		0.095	0.154	0.082	0.069	0.098	0.106	0.244	0.128	0.118	9,127	0.186	0.239	0,182	0.214
	1 haur			Нен	1.600		1.1.10	CEA-1	1.201	3	009.1	1,505	1.001	1.201		1.201	1.001	1.053	1,435	1,053	20.1	1,053	1.000	1.053	1,305	1.000	1.000	1,000	1.000	1.000	1,000	1.000	1.000	1.000	1,000
	# ! ! !			Ŀ	589	1 105	2 077	0,0,0	3,664	4 4 9 3	3.172	7.30/	3,192	3,565		2.818	2,123	2,780	2,999	2,775	2	2,138	1.384	2.489	2,388	2,183	2,023	0.877	1.667	1.811	1.679	1.148	0.895	1.172	1.000
			unionized		0.001	00 0	100.0	0.00	0.002	900	0,000	0.001	0.00	0.003		0.001	0.004	0,003	0.001	0.003	2	0.001	0.006	0.003	0.001	0.008	0.002	0.022	0,013	0.002	0.005	0.083	0.023	0.027	0.007
		lata		unionized	0,235	007 0	0 475	0.000	0.460	770 0	0/7*0	0,623	1.068	0.472		0.623	1.706	0.999	0.366	1,258		1,350	30,747	1.135	0.600	2,597	6.805	15,365	18,568	7.641	12,493	52,019	15,085	29.685	16.603
		Palouse ambient data		(J/be)	0,37	<u>a</u>	27.0	20.0	0.53	0	0,10	0.10	0.57	0,56		0.14	0.21	0.30	0.24	0.20	,	0.09	0.02	0.30	0.10	0.29	0.07	0.14	0.01	0.09	0.04	0.16	0.15	0.04	0.04
		SF Palous	tt 11 12 14 15 16 16 16 16 16 16 16 16 16 16 16 16 16	(89)	7.4		0 0		7.7			0.,	0.8	7.7		1.1	8.0	7,9	7,5	7.9		7.9	9.2	7.9	7.6	8.3	8.6	8.6	0.9	8.6	80	9.5	8.6		6,00
1001 · NEW 100				(1)	₩ <sup>*</sup> ?	. ~			1.3	, ,	7.5		3.2	1.6		2.0		5.2	<del>-</del> -	8.	;	0'6	15.3	6.8	7.4	œ -	9.8	21.9	12.6	11.4	12.5	18.0	21.6	17.7	20.0
				(cfs)	744.0	47.0	2 2	2 4 5	36.0	750.0	0.00	100.0	35.0	37.0	;	260.0	0.89	62.0	108.0	110.0		0.09	33.0	140.0	270.0	33.0	400,0	18.0	32.0	26.0	0'61	260.0	8,2	21.0	9.0
5101111000 to 1 161110				time	1440	1175	2113	1170	1150	155	0001	1130	1045	1155		1343	1800	1120	1205	1150		1430	1235	1110	1120	1155	1415	1225	1105	1145	1150	1620	1215	1120	1202
				ф	26	25	3 5	. 4	7	ñ	7 6	77	1	=		2	22	9	17	=		6	6	10	2	13	10	54	<b>c</b> c	r~	13	40	82	13	01
			date	month		-				c	4 6	7 '	2	7	٠	~	77	t-7	m	٢		•द	•	•	***	<b>4</b> 5	'n	CB	ל"ט	רש	ur;	49	9	-6	9
			6 6 6	year	1982	1983	499	1001	1986	1080	7001	001	1984	1986		7841	1983	1984	1985	1986		1982	1983	684	1985	1986	1982	1983	1984	1985	9861	1982	1983	1984	9861

Table la (cont d) - Calculation of acceptable MH3-M discharge concentrations for 5TP design flow conditions - Pullman, 9786.

		į	MH3-N	(mg/L)	90	00.1	00:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	00.1	1.00	1.00	1.00	90.	00.1	96:1	90	5.00	5.00	5.00	2.00					
			200	4 day	88	0.392	0.099	0.727	0,138	1.89	0,357	0.416	1.335	0.805	0.514	0.523	1.827	3,101	1.836	3,192	0.792	3.870	0,937	2.267	3,297	0.553	3,589	5,443	6.530	9.024	0.007
	P effluent	(1/ba) suo	#-0XX	1 hour	5 035	7.041	0.564	3.174	0,852	7.881	1.628	1,963	5,779	3, 106	2,115	2,537	7.666	17,492	7.266	12,436	3,348	27,527	6.274	8.387	12, 165	3.850	13,628	18.271	23,268	30.651	701.0
	neulthe STP efficentific	concentrations (mg/L)	X-2.4	4 day	0.073	0.061	0.057	0.061	0.050	0,062	0.054	0.043	090.0	0.056	0.051	0.038	0.052	0.017	0.034	0.036	0.048	0.009	0.018	0.039	0,052	0.012	0.047	0.043	0.044	0.069	6,000
	7	Ü	unionized NH3-N	1 hour	0.309	0.319	0.328	0.266	0,306	0.259	0.245	0.204	0.258	0.215	0.211	0.183	0.220	0.093	0.135	0,140	0.202	0.061	0.122	0,145	0.194	0.085	0.178	0.145	0.157	0.236	0001
	11 11 11 11 11 11 11 11		ance	4 day	2.617	2.202	2.061	2,183	1,777	2.232	1.928	1.550	2,141	1.998	1.836	1,354	1.879	0.593	1,224	1,289	1.716	0,307	0.653	1.401	1.881	0.438	1.681	1.554	1.581	2.492	047.0
5	.0.	į	allowance	1 hour	23, 162	23.970	24.626	19,943	22,990	19.469	18.371	15,290	19,398	16.133	15.820	13,755	16,502	866.9	10.139	10.510	15.171	4.566	9,150	10,847	14.527	6.383	13,359	10.916	11.789	17,715	10.0
China to the Contract of the C	SECTION CARS			upstream load	0.091	0.169	0.753	0.203	0,682	0.142	0.195	0.224	0.087	0.133	0.056	0,311	0.085	0.036	0,066	0.034	0.156	0.006	0.660	0.208	0.244	0.438	0.355	0.112	0.359	0.584	, ,
700,00	nazananan nazanan	608	acceptable nstream load	4 days	2,703	2.370	2.813	2.386	2.459	2,374	2.122	1.773	2.227	2.131	1.892	1,666	1.964	0.629	1.290	1.323	1.872	0,313	1.313	1.609	2.126	0.876	2.038	1.665	1.939	3.076	2
	*******	ene ixee	#ap	1 hour	23, 252	24,138	25.378	20.146	23.673	19,610	18,565	15.513	19,485	16.266	15.876	14.067	16.587	7.034	10,205	10.544	15.327	4,572	9.809	11,055	14.771	6.821	13,714	11,028	12.147	18,300	
		# E	unionized unionized	(J/bu)	0.041	0.041	0.041	0.038	0.041	0.036	0,037	0.031	0.039	0.025	0.030	0,026	0.031	0.010	0.017	0.018	0.027	0.004	0.015	0.013	0.018	0.011	0,015	0.012	0.010	9.011	
us	4 day			E	000	000.1	1.000	1.086	1,000	1,156	1.117	1.337	1.064	1.622	1.393	1.556	1,318	2,168	2,404	2.051	1.503	2.559	2.818	3,126	2.259	3.715	2,685	3,373	3,873	3.467	2
Uriteria calculation		************		Ratio	16.000	16.000	16.000	16,000	16,000	16,000	16.000	16.000	16,000	16.000	16.000	16,000	16.000	21,199	16.000	16.000	16,000	29.361	16.000	16,000	16,000	16.000	16,000	16.000	16,000	16.000	****
Criteria c		,	unionized	(3/6a)	0.228	0.249	0.235	0.197	0.239	0.185	0,191	0.160	0.201	0.132	0.153	0.137	0.162	0.069	0.089	0.093	0.142	0.040	0.076	0.068	0.095	0.058	0.080	0,060	0.052	0.059	>
	1 hour			FPH	1.000	1.000	1.000	1.000	1,000	1.001	1.000	1.000	1.000	1.000	1.000	1,000	1,001	1.435	1.000	1.118	1.000	2,068	1.000	1.000	1.001	1.000	1.001	1.053	1.053	1.053	>
				Н	0.966	0.859	0.908	1.086	0.895	1.156	1.117	1.337	1.064	1.622	1.393	1.556	1,318	2.168	2,404	2.031	1.503	2.559	2.818	3.126	2,259	3,715	2,685	3,373	3,873	3,467	3
			unionized	- 1	0.003	0,008	0.023	0,008	0.029	0.005	0,009	0.010	0.004	0,003	0.002	0.012	0.003	0.001	0.005	0,001	0.002	0.000	0.012	0.005	0.003	0.010	0.004	0,001	0.002	0,002	; >
		ata ata	7	unionized	6.129	15,649	58,174	8.372	35,971	3,291	15.038	10,379	4.472	6.921	9,965	7,223	2.868	0.533	1.859	1.126	6.037	0.221	1.943	1.723	1.591	2.209	1.306	0.796	0.675	0.770	
		SF Palouse ambient data	2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	(mg/L)	0.05	0,05	0.04	0.09	0.08	0.14	90.0	0,10	0.09	0.04	0.05	0,16	0,111	0.25	0.09	0.08	0.08	0.07	0.63	0.14	0.19	0,46	0.28	0.13	0.34	0.32	:
		SF Palouse	7	(0.5)	8.3	3.8	5.5	9.	9.1	8,0	E 10	8.6	 -:	8.5	8,6	8	8,0	7.5	8.1	7.8	₩.	7.2	8.2	8.3	8,0	9.4	9,0	7.9	7.9	~ · · ·	;
77.96.		1	;	(D)	20.5	22.2	21.4	18.8	21.6	17.9	18.4	15,8	14,1	13.0	15.2	13.6	16.0	8.8	7.3	9.6	<u>.</u>	6.4	5.0	5.5	8.2	1.0	5.7	2.4	<b>4</b> .0	2.0	;
15 - PULLING		1	2017	(C+S)	ių.	.0	0,9	5.0	**	5.7	4.0	0,4	0. *	8.9	5,2	5,0	5.0	5.0	7,3	7.0	9.9	7.0	10.0	0.91	15.0	9.0	18.0	20.0	24.0	10.0	•
of air design flow Conditions - rullman, 9/86				tise	1130	1220	1210	1210	1310	1240	1125	1155	1145	1135	1235	1210	1220	610	1115	1210	1120	800	1125	1215	1140	1205	1600	1055	1220	1200	ì
1011 UD 1382				ήaγ	ganer ganer	6	10	<b>c</b> c	11	23	**	**	17	*	27	=	6	20	16	52	o-		16	56	22	ō-	တ	28	50	I 0	
101 311			date	month	7		7	7	8	œ	ac	œ	<b>a</b> o	o-	0	o-	o-	10	10	10	10		==	=	=		12	1.2	15	77	:
				year	1982	1983	1984	1986	1982	1983	1484	1985	1986	1982	1983	1881	1986	1961	1982	1983	1984 1984	1861	1982	1983	1861	1985	1861	1 982	1983	1984	
						ς.																									

Table 1b - Calculation of acceptable NH3-W discharge concentrations STP inspection conditions - Pullean 9/86.

		MPDES MHT-N		(#d/F)																	5.00	9	00.5		5.00	9	2 2	8	8	00.	9	>>:	3 6	. 00
		20		4 day	787 947	70, 707	701.01	44.4	14.402	110 148	74 826	4.779	14,398		108,606	15,373	770 71	10.01	70. 790	7	27.725	0.470	15, 721	117.038	3,979	21.029	0.787	588	1.693	0.868	g07 8-	200	0.250	0.624
P effluent	(7/ <b>b#</b> ) suo	第一次出版		1 hour	1255 330	170 27	20 204	23.197	49.817	1257, 246	279.773	77.747	50.519		290.074	\$7.542	01.0 14	148 581	88.759		74, 634	2,218	111.023	141.048	16.148	65.477	4,392	2,830	5. 703	3.024	000	2 856	1 201	2.364
allowable STP	concentrations (mg/L)	*- CEX	61 61 61 61 61 61 61 61 61 61 61 61 61 6	4 day	0.665	2110	0.046	0.037	9,066	0.837	0.468	0.067	0.068		0.677	0.262	0.169	0.167	0,382		0.374	0.208	0.405	0.672	0.103	1.431	9,121	0.100	0.129	0,108	-2,761	0.075	0.075	0.104
Tie.	0	N-CHW basington		1 hour	2,950	0.334	0.197	0.133	0,229	3,384	1,436	0.296	0.238		1.807	0.811	0.541	0.617	1.117		1,008	0.682	1.260	2.046	0.419	4.452	0,675	0.525	0.436	0.378	3.069	0.430	0.575	0.393
61 81 82 88 89 80 81 67 64	,	ance		4 day	15.805	2.475	1.088	0.882	1.575	19,905	11,116	1,584	1,615		16.083	6.234	4.024	3,854	4.087		8.849	4.894	9.637	15.978	2.456	34.013	2.875	2,595	3,075	2.576	-65,625	1.793	1.777	2.461
(p)	•	SIP		1 hour	147.619	16.734	9.865	6,663	11.467	169.324	71.846	14.826	11.932		90,430	40.586	27,059	30,875	55.874		50.419	34.125	63.056	102.396	20.985	222,794	33,772	26.294	21,807	18.907	153,552	21.515	26, 753	19.642
NH3-N (16s/d)			upstream	load	3,487	0.285	0.672	0,167	0.473	1.965	909.0	1,148	0.527		1.222	1.313	1.002	0.511	1,492		0.393	1.094	2.569	0.873	1.340	10,270	2,087	2.242	0.642	0.512	116,639	1.000	1,024	0.286
onized		acceptable nstream load		4 days	19,292	2.960	1.760	1.049	2.048	21.870	11.722	2.732	2,142		17.305	7.547	5.025	4,365	10.579		9.289	5.988	12,206	16.851	3.796	44,283	4.962	4.837	3,718	3,088	51.014	2.791	4.800	2.747
# # # # # # # # # # # # # # # # # # #	Bax i sus	, and	:	1 hour	151,106	17,018	10,537	6.830	11.940	171,288	72,452	15.974	12,459		91.653	41.899	28.061	31.386	57.366		50,812	35,219	65,626	103,270	22,324	233,064	35,859	28.535	22,450	19.419	270.191	22,515	29.777	19.929
		unionized	X-2HX	(#å/F)	0,005	0.017	0.010	0.010	0.009	0,005	0.012	0.013	0.010		0.012	0.019	0.014	0.007	0.017		0.018	0.030	0.016	0.011	0.019	0.020	0.041	0.025	0.023	0.024	0.036	0.041	0.035	0.041
4 day	***************************************			Е	3,589	3,105	3,873	3.664	3,639	3,192	2,307	3,192	3.565		2.818	2,123	2,780	2,999	2.275		2,138	1,384	2,489	2,388	2,183	2.023	1,000	1.667	1.811	1.679	1,148	1.000	1.172	1.000
	H H H H H			Ratio	23,943	16.000	16.000	16.000	16.000	23,943	18.525	16.000	16.000		16.000	16,000	16.000	21.199	16,000		16.000	16.000	16.000	18,525	16,000	16,000	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000
		ufinizeria ufinized	X-23-X	(mg/L)	0.037	0.062	0.052	0.052	0.049	0.042	0.071	0.067	0.050		0.063	0.101	0.073	0.020	0.089		0.095	0.154	0.082	0.069	0.098	0.106	0.244	0.128	0.118	0.127	0.186	0.239	0,182	0.214
1 hour				FPH	1.600	1.118	1,053	1.138	1.201	1.600	1,305	1,001	1.201		1.201	1,001	1.053	1.435	1.053		1.053	1.000	1.053	1.305	1.000	1,000	1.000	1.000	1.000	1,000	1.000	1.000	1.000	1,000
1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		u no		Н	3,589	3,105	3.873	3.664	3,639	3,192	2,307	3,192	3,565		2.818	2,123	2.780	2.999	2.275		2.138	1,384	2,489	2,388	2,183	2,023	0.877	1.667	1.811	1.679	1.148	0.895	1,172	1.000
		1 2	NH3-X	( (mg/L)	0.001	0,001	0.004	0,002	0.002	0.000	0.001	0.006	0.003		0.001	0.004	0.003	0.001	0.003		0.001	0.006	0,003	0.001	0.008	0,005	0.022	0.013	0.002	0.005	0.083	0.023	0.027	0.007
j	Sh Palouse agoing data	1	7 843	unionized	0.235	0.699	0.675	0.574	0.460	0.270	0.625	1.068	0,472		0.623	1.706	666.0	0,366	1,258		1,350	30,747	1.135	0.600	2,597	6.805	15,365	18,568	7.641	12.493	52,019	15,085	29,682	16.603
-	Sh Palouse ambient data	f 7 9 8 8 8 8 8 8 8	NH3-N	(7/6w)	0.37	0.18	99.0	0.36	0.53	0.18	0.10	0.57	0.56		0.14	0.21	0.30	0.24	0.20		0.06	0.02	0.30	0.10	0.29	0.07	0.14	0.07	0.06	0.04	0.16	0.15	0.04	0.04
4	St Palous	* * * * * * * * * * * * * * * * * * *	F.	(20)	7.4	.00	7,9	7.8	7.7	7.4	7.6	9.0	7.7	,	7.7	8.0	6.7	7.5	6		7.9	4.2	7. 9	7.6	8.2	8.6	9.6	9.0	8.6	8,8	6,5	8.6	0-	8.7
		: : : : : : :	temp	(0)	5.	3,6	4.0	1.2	1.3	3.2	7.9	3.2	1.6	:	0 0	٠.	5.5	1,4	8.1		0.0	15.3	8.9	7.4	69.7	9.8	21.9	12.6	11.4	12.5	18.0	21.6	17.7	70.0
	6 6 6 6 6 6 6 6 6		410#	(cfs)	744.0	42.0	28.0	15.0	36.0	750.0	180.0	35.0	37.0	;	260,0	63.0	62.0	108.0	110.0		90.0	33.0	140.0	270.0	33,0	400.0	18.0	32.0	26.0	19.0	266.0	2.8	21.0	8.0
			,	t t	1440	1125	1115	1130	1150	1555	1150	1045	1155	;	1545	1800	1120	1205	1150		1430	1235	1110	1120	1155	1415	1225	1105	1145	1150	1620	1215	1120	1205
				λeρ	26	22	17	12	4	5	22	1	11		13	22	9	12	Ξ		<u>o-</u>	6	01	2	13	10	24	<b>œ</b>	-	12	9	28	12	10
		date		worth			•			2	2	7	2	,	~	24	64	P7	<b>*</b> >		4	≪4	**	•	W.T	кo	sc.	m	iO.	S	9	9	9	40
				year	1982	1983	1984	1985	9851	1982	1983	1984	1986		7841	1983	1984	1985	1986		1882	1983	1861	1985	9841	1982	1983	1984	1882	1986	1982	1983	1984	1986

Table 1b (cont d) - Calculation of acceptable NH3-N discharge concentrations SIP inspection conditions - Pullman 9/86.

		MPDES	HH3-M	(Mg/L)	1.00	1.00	00.1	1.00	1.00	00.	06.1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1,00	1.00	3.8	5.00	5.00	2.00	5.00					
_			38E	4 day	1.443	0.455	0.112	0.861	0.148	2.291	0.412	0.474	1,563	1.024	0.621	0.598	2.190	3,703	2,291	3.986	0.959	4.841	1.022	3,022	4.379	0.574	4.804	7.454	9.074	12,853	0.746
ine [23e 8]	7/00) 500		NH-CHN	1 hour	5.725	2.256	0.641	3,571	0.941	8,981	1.797	2.164	6.395	3.694	2,393	2,843	8.640	19,714	8.479	14.465	3.830	32,038	7,435	10.572	15,240	4.456	17,360	23.579	30,970	42.128	9,541
from 12 to 6 15 of 12 conf	concentrations (mg/L)		NH3-N	4 day	0.088	0.071	0.065	0.072	0.053	0.075	0.062	0.049	0.070	0,071	0,062	0.043	0.063	0.020	0.043	0.045	0.058	0.011	0.020	0.052	0.070	0.013	0.063	0.059	0.081	660.0	0.008
7	; 0		unionized NH3-N	1 hour	0,351	0.353	0.373	0.299	0.339	0,296	0.270	0.225	0.286	0.256	0.238	0,205	0.248	0.105	0.138	0.163	0.231	0.071	0.144	0.182	0.242	0.098	0.227	0.188	0.209	0.324	0.104
			INCE	4 day	2,102	1.692	1.551	1.714	1.267	1,782	1,472	1,168	1.662	1.684	1,471	1.027	1.493	0.469	1.012	1.067	1.377	0.254	0.472	1.238	1.656	0,301	1.491	1,410	1,456	2,352	0.194
(þ/		STP	allowance	1 hour	17,557	17.667	18.662	14.959	16.944	14.790	13,523	11.239	14,311	12,794	11.934	10.275	12,399	5.258	7.887	B.150	11.569	3,543	7.229	9,115	12.133	4.926	11.345	9.392	10,461	16.232	5.214
unionized NH3-N (lbs/d)			and Train	load	0.091	0.169	0.753	0.203	0.682	0,142	0.195	0,224	0.087	0.133	0.026	0,311	0.085	0.036	0.066	0.034	0.156	0.006	0,460	0,208	0.244	0.438	0.355	0.112	0.359	0.584	0.547
unionized	<b>6</b> D <b>6</b>	table	ar load	skep y	2.193	1.861	2,304	1.917	1.949	1,933	1.666	1.392	1.749	1.817	1,527	1.338	1.578	0,505	1,078	1.101	1,533	0.260	1,132	1.446	1,900	0,739	1.846	1.522	1.814	2.937	0.841
***************************************	# D # 1 X 19 ##	acceptable	downstream load	1 hour	17.648	17.836	19.414	15.162	17.626	14,932	13,718	11.463	14.397	12.927	11.990	10,587	12.484	5.294	7.953	8.184	11.725	3,549	7.888	9,323	12,377	5.364	11,700	9.503	10.820	16.817	5.861
	***************************************	Criteria	unionized NH3-N	(#d/L)	0.041	0.041	0.041	0.038	0.041	0.026	0.037	0.031	0,039	0.025	0.030	0.026	0.031	0.010	0,017	0.018	0.027	0.004	0.015	0.013	0.018	0.011	0.015	0.012	0.010	0.011	0.011
A day	************			Ε	1,000	1.000	1,000	1.086	1.000		1.117	1.337	1.084	1.622	1.393	1,556	1.318	2,168	2,404	2.051	1.503	2.559	2.818	3,126	2,259	3,715	2.485	3,373	3.873	3,467	3,793
	000000000000000000000000000000000000000			Ratio	16.000	16.000	16.000	16.000	16,000	16,000	16.000	16,000	16.000	16,000	16.000	16.000	16,000	21,199	16,000	16,000	16.000	29,361	16,000	16,000	16.000	16.000	16.000	16.000	16.000	16,000	16.000
		Criteria	unionized MH3-N	(#d/f)	0.221	0.249	0.235	0.197	0.239	0,185	0,191	0.160	0,201	0.132	0.153	0.137	0.162	0.069	0.089	0,093	0.142	0.040	0.076	0.068	0,095	0.058	0.080	090.0	0.052	0.059	0.056
1 haur				Hd3	1.000	1.000	1.000	1.000	1.000	1.001	1,000	1.000	1.000	1.000	1.000	1.000	1.001	1.435	1.000	1.118	1.000	2.068	000.1	1.000	1.001	1,000	1.001	1.053	1,053	1.053	1,000
1	***************************************			Е	0.966	0.859	0.408	1,086	0.895	1,156	1.117	1.337	1.064	1.622	1,393	1.556	1.318	2.168	2.404	2.051	1.503	2.559	2.818	3.126	2,259	3,715	2,685	3,373	3,873	3,467	3,793
		***************************************	unionized NH3-N	( (mg/L)	0.003	0.008	0.023	0.008	0.029	0,005	0.004	0.010	0.004	0.003	0.002	0.012	0.003	0.001	0.002	0.001	0.005	0.000	0.012	0.002	0.003	0.010	0.004	0.001	0.002	0.002	0.012
	fata	***************************************	NH3	unionize	6.129	15,649	58,174	8,372	35,971	3,291	15,038	10.379	4.472	6.921	9.965	7,223	2.868	0,533	1.859	1,126	6.037	0.221	1.943	1.723	1.59	2.209	1.306	0.796	0.675	0.770	1.092
	SF Palouse ambient data	化甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基	NH3-N	(#d/F)	0.05	0.02	0.04	0.09	0,08	0.14	0.06	0.10	0.09	0.04	0.05	0.16	0.11	0.25	0.09	0.08	0.08	0.07	0.63	9.14	0.19	0.46	0.28	0.13	0.34	0.32	1.10
	SF Palous	**********	H	(RS)	8.2	8,6	5,51	8.8	9.1	8,0	8.7	8.6	8,1	8,5	8,6	8.5	8.0	7.5	8.1	7.8	Ð. Þ	7.2	8.2	8,2	9.0	<b>4</b> .	8.9	1.9	7.9	7.9	9.1
		***************************************	4	9	20.5	22.2	21,4	18.8	21.6	17.9	18.4	15,8	19.1	13.0	15.2	13.6	16.0	8	7,3	9.6	14.1	4.9	5.0	3.5	8.2	1.0	5.7	2.4	0.4	2.0	0.7
		## ## ## ## ## ## ## ## ## ## ## ## ##	f) 08	(££3)	5.5	0,4	6.0	5.0		5,7	<b>4</b> .0	0 <b>.</b>	4.0	8.0	5.2	5,0	5.0	5,0	7.3	7.0	6.9	7.0	10.0	16.0	12.0	8,0	18.0	20.0	29.0	44.0	0.01
			•	=======================================	1130	1220	1210	1210	1310	1240	1125	1155	1145	1135	1235	1210	1220	610	1115	1210	1120	800	1125	1215	1140	1205	0091	1055	1220	1200	1200
				day.	=	19	10	8	11	23	<del>*</del>	13	12	*	27	Ξ	ō-	20	16	22	6	=	91	54	13	3.6	ω	28	92	==	0
			date	sonth	7	7	r~	7	80	œ	89	æ	œ	b	6	ō.	6	10	10	10	0	=	Ξ			Ξ	13	12	12	22	13
				year	1982	1983	1984	1986	1982	1983	1984	1985	1986	1982	1983	1984	1986	1981	1982	1983	1984	1861	1982	1983	1984	1985	1861	1982	1983	1984	00 00 10 10 10 10 10 10 10 10 10 10 10 1

APPENDIX II

## LABORATORY PROCEDURAL SURVEY

Disc	harge	er:	City of Pullman
			umber: Wa-00-4465-2
Date	: · <u>·</u>	9-1	6-86
Indu	ıstria	a <b>1/M</b> un	nicipal Representatives Present: alprouty, Terry Daksen.
	ncy Re		entatives Present: <u>[ar] N., [arry P., Mark H.</u>
I.	COMF	POSITE	SAMPLES
	A.	Co11	ection and Handling
		1.	Are samples collected via automatic or manual compositing method? <u>Quality Control Equip.</u> co
			a. If automatic, are samples portable 2 or permanently installed $\times 2$ ?
			Comments/problems Microprocessor drifts
			Be-program occassionally.
		2.	What is the frequency of collecting composite samples?
			proportional to flow. Eff 45 min.
			approx. 1/hr
		3.	Are composites collected at a location where homogeneous conditions exist?
			a. Influent? <u>Kes</u>
			b. Final Effluent? <u>Xes</u>
			c. Other (specify)?
		4.	What is the time span for compositing period?
			Sample aliquot? 150 mls per 45 minutes
		5.	Is composite sample flow or time proportional?

	6.	Is final effluent composite collected from a chlorinated or non-chlorinated source? <u>de-chlorinated</u>
	7.	Are composites refrigerated during collection? <u>Yes</u>
	8.	How long are samples held prior to analyses?
	9.	Under what condition are samples held prior to analyses?  a. Refrigeration?  b. Frozen?  c. Other (specify)?
	10.	What is the approximate sample temperature at the time of analysis?
	11.	Are compositor bottles and sampling lines cleaned periodically?    165
	12.	b. Method? bottles - phosphale - Alloward lines - bleach, sponge through line.  Does compositor have a flushing cycle? Yes  a. Before drawing sample? Yes  b. After drawing sample? Yes
	13.	Is composite sample thoroughly mixed immediately prior to withdrawing sample?
Recommen	ndation	ns:
<i>45e</i>	a	Colcium Hypochlarite solution for cleaning bottles.
Water and a Collection for the agency of the same		
жын нубектей көйбөлөгө жаруун айылдаг жарысаат (н 18 Мас Маринун казары ста		
No and designation of the last		

# II. BIOCHEMICAL OXYGEN DEMAND CHECKLIST

A.	Tech	nique
	1.	What analysis technique is utilized in determining BOD <sub>5</sub> ?
		a. Standard Methods? K Edition?
		b. EPA?
		c. A.S.T.M.?
		d. Other (specify)?
В.	Seed	Material
	١.	Is seed material used in determining BOD? 15
	2.	Where is seed material obtained? <u>Sec. eFF</u>
	3.	How long is a batch of seed kept? 24 hours
	•	and under what conditions? (temperature, dark)
		and under what conditions: (cemperature, dark)
	4	Now is good material averaged for use in the DOD to the
	4.	How is seed material prepared for use in the BOD test?
		GINECITY 10 20/1/83
Recommend		•
Colle	cT	seed material the day before analysis.
	ct	seed From primary.
	·	
divide the sign and the commence of the sign and the sign		

		Reagent water utilized in preparing diultion water is:
		a. Distilled? X
		b. Deionized?
		c. Tap, chlorinated non-chlorinated
		d. Other (specify)?
	2.	Is reagent water aged prior to use? 2 days
		How long?, under what conditions?
		in the Incupator (dark)
meno	datio	ns:
ngan ngan ngan ng		
D.	Dil	
D.		ution Water  Are the four (4) nutrient buffers added to the reagent water?
D.		ution Water  Are the four (4) nutrient buffers added to the reagent water?
D.		Are the four (4) nutrient buffers added to the reagent water?  a
D.	1.	Are the four (4) nutrient buffers added to the reagent water?  a mls of each nutrient buffer per
D.	2.	Are the four (4) nutrient buffers added to the reagent water?  Are the four (4) nutrient buffers added to the reagent water?  a

Reagent Water

C.

an.	d n.	s: hosphate buffer on day of analysis
	<b>T</b>	esperante de la company de de la company de
E.	Test	Procedure
	1.	How often are BOD's being set up? 1/4 days
		What is maximum holding time of sample subsequent to end
		composite period? 2-4 hours
	2.	If sample to be tested has been previously frozen, is it
		reseeded?
	2	Does cample to be tested centain meridual chlomine?
	3.	Does sample to be tested contain residual chlorine?  If yes, is sample
		a. Dechlorinated?
		How?
		b. Reseeded? Yes
		How? <u>sec. effluen</u> T
	4.	Is pH of sample between 6.5 and 8.6? Yes approx. 6.5
		If no, is sample pH adjusted and sample reseeded?
	5.	How is pH measured? Orion mode no. 30/
		a. Frequency of calibration? darly
		b. Buffers used? 4, 7, 9

/.	Is the five (5) day DU depletion of the dilution water (blank) determined? $\sqrt{e_5}$ , normal range? $o_2$ $o_3$
8.	What is the range of initial (zero day) DO in dilution water blank? <u>6.8-7.6 mg/L</u>
9.	How much seed is used in preparing the seeded dilution water?
10.	Is five (5) day DO depletion of seeded blank determined? Ves If yes, is five (5) day DO depletion of seeded blank approximately 0.5 mg/l greater than that of the dilution water blank?
11.	Is BOD of seed determined? US
12.	Does BOD calculation account for five (5) day DO depletion of
	a. Seeded dilution water? <u>Ves</u>
	How? seed Correction Factor in std. methods
	b. Dilution water blank? no 0.1-0.2 depletion
	How?
13.	In calculating the five (5) day DO depletion of the sample dilution, is the initial (zero day) DO obtained from
	a. Sample dilution?
	b. Dilution water blank?
14.	How is the BOD5 calculated for a given sample dilution which has resulted in a five (5) day DO depletion of less than 2.0 ppm or has a residual (final) DO of less than 1.0 ppm?
15.	Is liter dilution method or bottle dilution method utilized in preparation of
	a. Seeded dilution water? bottle liter
	b. Sample dilutions?
16.	Are samples and controls incubated for five (5) days at 20°C ± 1°C and in the dark? <u>Ves</u>

17.	How is incubator temperature regulated?
	temp controlled Thermostat
3.0	,
18.	Is the incubator temperature gage checked for accuracy?
	a. If yes, how? Thermoneter in Flack of 1/20
	b. Frequency? welly
19.	Is a log of recorded incubator temperatures maintained? 455
	a. If yes, how often is the incubator temperature monitored/checked? Weekly
20.	By what method are dissolved oxygen concentrations determined?
	Probe \( \times \) Winkler \( \frac{\frac{a}{b}raled}{\times} \) Other \( \times \times \times \)
	a. If by probe:
	1. What method of calibration is in use? <u>heck with</u>
	Winkler and our Calibration every 4 days
	2. What is the frequency of calibration? Weekly with winks
	b. If by Winkler:
	1. Is sodium thiosulfate or PAO used as titrant? Thio.
	2. How is standardization of titrant accomplished?
	Ri-10date
	3. What is the frequency of standardization?
	4-5 Weeks
Dogowendstion	
Recommendation	
	ete pt meter every 2 hours. Buffet
	delation water to raise DO To 8.0- 9.0 mg/l
	super saturation at This Elev. 2300 FT.
- 3Tandard	rze thio every 2 weeks.
	e 14th Ed. of Standard Methods.
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- F. Calculating Final Biochemical Oxygen Demand Values Washington State Department of Ecology
  - 1. Correction Factors
    - a. Dilution factor:

- b. Seed correction:
  - = (BOD of Seed)(ml of seed in l liter dilution water)
    1000
- c. F factor ~ a minor correction for the amount of seed in the seeded reagent Versus the amount of seed in the sample dilution:

- 2. Final BOD Calculations
  - a. For seed reagent:

(seed reagent depletion-dilution water blank depletion) x D.F.

b. For seeded sample:

(sample dilution depletion-dilution water blank depletion-scf) x D.F.

c. For unseeded sample:

(sample dilution depletion-dilution water blank depletion) x D.F.

3. Industry/Municipality Final Calculations

Reco	nmend	ation	
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		ales a d'Oly d'Ay Juya chagailteann ar gaid	
-	and the same of th	and the constitution of th	
III.	TOTA	L SUS	PENDED SOLIDS CHECKLIST
	A.	Tech	nique
		What analysis technique is utilized in determining total suspended solids?	
			a. Standard Methods? Edition
			b. EPA?
			c. A.S.T.M.?
			d. Other (specify)?
	В.	Test	Procedure
		1.	What type of filter paper is utilized:
			a. Reeve Angel 934 AH?
			b. Gelman A/E?
			c. Other (specify)?
			d. Size?
		2.	What type of filtering apparatus is used?  ———————————————————————————————————
			- 170001) [ FULL DIE ; WHO MEN NO. 1 KOUTTHE MISS ETC
		3.	Are filter papers prewashed prior to analysis? Ves
			a. If yes, are filters then dried for a minimum of one hour yes at 103°C-105°C yes?
			b. Are filters allowed to cool in a dessicator prior to weighing? Ves

4.	How are filters stored prior to use? In dess icator						
5.	What is the average and minimum volume filtered?						
6.	How is sample volume selected?						
	a. Ease of filtration? X						
	b. Ease of calculation?						
	c. Grams per unit surface area?						
	d. Other (specify)?						
7.	What is the average filtering time (assume sample is from final effluent)?						
8.	How does analyst proceed with the test when the filter clogs at partial filtration?						
9.	If less than 50 milliliters can be filtered at a time, are duplicate or triplicate sampe volumes filtered? yes						
10.	Is sample measuring container; i.e., graduated cylinder, rinsed following sample filtration and the resulting washwater filtered with the sample?						
11.	Is filter funnel washed down following sample filtration?						
	when using millipore						
12.	Following filtration, is filter dryed for one (1) hour, cooled in a desscator, and then reweighed?						
13.	Subsequent to initial reweighing of the filter, is the drying cycle repeated until a constant filter weight is obtained or until weight loss is less than 0.5 mg?						

14. Is a filter aid such as cellite used? No
a. If yes, explain:
Recommendations:
wit
wt
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- C. Calculating Total Suspended Solids Values Washington State Department of Ecology
  - A. mg/1 TSS =  $\frac{A-B}{C} \times 10^6$ 
    - 1. Where: A = final weight of filter and residue (grams)

B = initial weight of filter (grams)

C = Milliliters of sample filtered

2. Industry/Municipality Calculations

Recommendations:					
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	rediction and an experience of the contraction of the contraction of the contraction of the contraction of the		Million Market and Commission African Company of the Company of th		
SPLIT SAMPLE RESULT	rs:				
Origin of Samp	ole				
Collection Da	te	aller was not never and the best statements when the second second second second second second second second se			
В	00		TSS	EPA BO	D_Standard
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